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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] About the recording device (printer) which records on recorded media, such as paper, in ink, especially, this invention heats ink with a heating element, generates air bubbles in ink, and relates to recorded media from a nozzle by expansion of air bubbles at the structure of the regurgitation [ink] and the head of the ink jet printer which records by making it fly, i.e., an ink discharge part.
[0002]
[Description of the Prior Art] In recent years, a printer is spreading as the hard printing terminal equipment used for a computer, facsimile apparatus, a word processor, etc., and a hard copy unit. Although the thing of various kinds of record principles is put in practical use as a printer, the ink jet printer attracts attention especially as what can realize high definition printing with a low drive sound and a low power at high speed. An ink jet printer makes ink fly intermittently according to a record signal, imprints ink in the shape of a dot (dot) to recorded media, and constitutes printing record from a nozzle which builds in the energy generation component which generally generates the energy for carrying out the regurgitation of the ink. As an energy generation component, the electric resistance heating element for making ink heat and foam is used preferably. And in order to enable it to record two or more dots on coincidence using one printer head, the printer head for ink jet printers is considered as the configuration which arranges two or more energy generation components on an insulating base. And a printer head is classified into a side chute type thing and an edge chute type thing according to the relation between an insulating base and the discharge direction of ink. The case where an electric resistance heating element is used as an energy generation component is hereafter mentioned as an example, and a printer head conventional side chute type and an edge chute type printer head are explained.
[0003] Drawing 7 is drawing showing the cross-section structure of the printer head of an ink jet printer conventional side chute type.
[0004] The insulating base 3 by which many heating elements 5 which are field-like electric resistance objects have been arranged in one field is formed in the printer head 1. In the field of another side of an insulating base 3, the ink container 2 with which it fills up with ink is arranged. Each heating element 5 supports the dot, respectively, and the ink supply pipe 4, the ink heating container 6, and the ink regurgitation nozzle 7 are formed every heating element 5. The ink supply pipe 4 has penetrated the insulating base 3, in order to supply ink to each ink heating container 6 of the ink container 2. In the ink heating container 6, the heating element 5 has arranged on the base, and the ink regurgitation nozzle 7 arranges so that this heating element 5 may be countered. In order to realize high resolution and high definition printing, these are formed minutely. By arranging recorded media, energizing to a heating element 5 and making it generate heat according to a record signal so that the ink regurgitation nozzle 7 may be countered, the ink 12 in the ink heating container 6 foams and expands (air bubbles 9), about seven ink regurgitation nozzle ink does the regurgitation and flight of in the direction of recorded media by the pressure, discharge and the minute ink droplet 8 collide with a recorded-media front face, and ink is imprinted.
[0005] In an ink jet printer, each ink regurgitation nozzle 7 corresponds to one color, respectively. Therefore, in order to realize color printing of the high definition and the Takashina tone with the demand increasing in recent years, while gathering and using the head for every color as the so-called multi-head, it is necessary to make dot size still finer, and the ink supply pipe 4, a heating element 5, and the ink discharge opening 7 must also be formed more minutely.
[0006] The printer head of 300dpi (the number of dots of per 1 inch [dpi= dots per inch and] (25.4mm)) generally realized now arranges the ink regurgitation nozzle 7 whose diameter of opening is 20 micrometers in 80-micrometer pitch, and is constituted. in a future highly minute head, an ink regurgitation nozzle is arranged in 40-micrometer pitch, and an ink regurgitation nozzle is arranged [the head of 600dpi] in 20-micrometer pitch by the head of 1200dpi, for example -- if it kicks, it will not become. In order to realize highly minute printing, the magnitude permitted as an area of the heating element 5 which are each device for the regurgitation of ink, especially a field-like electric resistance object becomes still smaller. Therefore, generally the ink supply pipe 4, a heating element 5, and the ink regurgitation nozzle 7 are minutely formed with a phot lithography techniques or a laser-beam-machining technique on this insulating base 3, using the silicon substrate which oxidized the front face as an insulating base 3. furthermore, the pitch (the opening pitch A --) which is equivalent to 300dpi for every train as shown in drawing 7 Because arrange the ink regurgitation nozzle 7 in two trains so that it may be set to 80 micrometers here, and only the distance (here 40 micrometers) of the one half of the opening pitch A shifts and arranges such regurgitation nozzle train 7a and regurgitation nozzle train 7b Though it is an object for 300dpi as a dimension of each device, the printer head corresponding to the recording density of 600dpi can be obtained, and it becomes possible to suppress contraction of the dimension permitted by each

device for the ink regurgitation. If the number of regurgitation nozzle trains is increased, the printer head of high resolution can be obtained more. Moreover, it becomes possible to form various kinds of functional devices for driving a heating element 5 according to a record signal in an insulating base 3 at a monolithic by using the silicon substrate which has the scaling film as an insulating base 3.

[0007] Drawing 8 shows the conventional edge chute type printer head 1. The ink container 2 and each heating element 5 are arranged at the same insulating base 3 side. Therefore, the end of the passage-like ink heating container 6 carries out opening outside as an ink regurgitation nozzle 7, and the other end is open for free passage in the ink container 2 as an ink supply pipe 4. The longitudinal direction of a list and the ink heating container 6 has a heating element 5 perpendicular to about 1 train with this edge chute type of printer head 1 in an parallel direction on the surface of recorded media on the surface of recorded media. By sticking and carrying out a laminating also with an edge chute type printer head, it can become possible to establish two or more regurgitation nozzle trains, contraction of the dimension of each device can be suppressed, and high resolution-ization can be realized.

[0008] By the way, the demand of carrying and using a printer is increasing and the demand which reduces power consumption in the printer which uses a heating element, and extends the time amount which can be worked has arisen from this demand not to mention the miniaturization of a printer, and highly-minute-izing. In order to fill the demand which reduces power consumption, reduction of heating element drive power, i.e., the miniaturization of a heating element, and high electric resistance-ization are called for.

[0009] Although the tantalum nitride (Ta2N) thin film which is excellent in respect of high resistance, thermal resistance, a mechanical strength, etc. is used as an ingredient for the heating elements of an ink jet printer, compared with Ta2N, high resistance thin films, such as a TiAlN thin film with still larger specific resistance and a MoSi thin film, are also examined as a candidate of a heating element ingredient from the demand of a miniaturization of a heating element which was mentioned above.

[0010] Although a heating element 5 is arranged in the location [directly under] of the ink regurgitation nozzle 7 as it was shown in drawing 7 , when it was a side chute type printer head, and it will be arranged in the middle of the passage-like ink heating container 6 as shown in drawing 8 if it is an edge chute type printer head Even if it is which case, the expansion pressure force of the air bubbles 9 by heating is ****ed to the internal pressure of the ink container 2, and is concentrated in the direction of the ink regurgitation nozzle 7. It is also performed that arrange a bank 10 in the middle of the ink supply pipe 4, and the device which raises the pressure drag by the side of the ink container 2 gives.

[0011] The front face of a heating element 5 is covered with the hard insulator layer 11 in many cases for the purpose of prevention of the exfoliation from the insulating base 3 of the heating element thin film by the mechanical shock by reservation of the electric insulation with ink, and the pulsation at the time of cellular expansion, and destruction etc. There are some which mixed the color and the pigment type particle as an ingredient of ink 12, and a device which prevents printing of the ink by generation of heat is also made.

[0012]

[Problem(s) to be Solved by the Invention] In order that the printer head for ink jet printers may realize high resolution and high definition printing, minor-diameter-izing of the opening diameter of an ink regurgitation nozzle, contraction-izing of discharge opening spacing, the miniaturization of a heating element, high resistance-ization, etc. are tried. However, if the electric resistance heating element which has arranged the electrode on both sides of the resistance film is assumed, the miniaturization of a heating element will mean compaction of the die length of a resistance part, and the electric resistance of a heating element will fall. Although what the resistance film is made thinner for (the cross section is made small) can raise electric resistance, if the impact of carrying out a temperature up to about 500 degrees C or foaming contraction is assumed, when the resistance film is made thin, the mechanical endurance of a heating element will become a problem. Moreover, the size of the ink droplet made to fly becomes small inevitably by the miniaturization of an ink discharge opening. When it assumes making a smaller ink droplet project and fly and recording on the field of the same area as usual, the time interval which makes an ink droplet fly is shortened, namely, it must stop having to perform heating and cooling of ******** for a short time. From now on, a heating element will be required to excel also in the heat dissipation function as naturally heating effectiveness being good. With an ingredient with the sufficient ink to heat conduction itself, using the silicon base with which the front face oxidized as an insulating base becomes the factor which bars the temperature rise in the short time of a heating element, although it is convenient from things to heat dissipation. In the printer head of the gestalt which arranges the heating element of ink passage like a thing conventional edge chute type especially, since dissipation of the heat which minded ink depending on the volume of an ink passage part becomes remarkable, the problem that the power which must be impressed to a heating element increases at the time of generation of heat, or the heating response characteristic of a heating element falls arises.

[0013] The thing using resin, glass, various ceramics, etc. as an insulating base which there are some which formed the anodic oxide film in the front face as an insulating base besides the silicon substrate by which the thermal oxidation film was formed in the front face using the aluminum which is a high temperature conduction ingredient, and consists of a low-fever conduction ingredient can be considered. Among these, since a glass base can carry out patterning of the wiring in the design Ruhr equivalent to the case of the conventional silicon substrate cheaply by using a phot lithography techniques as compared with a silicon substrate as the example of use to a display panel in recent years proves, it is an ingredient promising when supplying a printer head cheaply. And if it takes into consideration that the occupancy area of input wiring of those other than the functional device in an insulating base increases when the number of nozzles increases, it is disadvantageous to use an expensive base only as a

support base, in view of cost.
[0014] On the other hand, when the base of the part directly under a heating element is thick, this part will act as an accumulation layer, it becomes difficult to make ink fly continuously in a short cycle period, and the device on structure is needed. Moreover, when [like polyimidoamide] a flexible heat-resistant-resin film is mechanically used as an insulating base, an insulating base will buffer the pressure of foaming and there is a fault that the transmission efficiency of the pressure to ink falls.
[0015] High definition printing is possible for the purpose of this invention at high speed, and it is a low power and is to offer the printer head which can be manufactured by low cost.
[0016]
[Means for Solving the Problem] The printer head of this invention has an insulating base and two or more heating elements arranged on said insulating base. In the printer head which records by heating the ink of a liquid phase condition with said heating element, and making ink fly from an ink regurgitation nozzle with evaporation and the expanding pressure of said ink The pressurized container which it is prepared for said every heating element, and has the heating element concerned in an internal surface, and said ink regurgitation nozzle is formed as a through tube, and carries out constant-rate maintenance of said ink, It has the ink feed holes supplied to the pressurized container which carries out opening and corresponds said ink so that it may be open for free passage in the ink container which was prepared in a part for the core of the exoergic field by the heating element concerned for said every heating element, and was filled up with ink and said insulating base may be penetrated.
[0017] In this invention, said two or more pressurized containers are constituted as a thing of one, and an adjoining pressurized container can share the septum which isolates the thermal-expansion pressure of the ink by heating of a heating element mutually.

[0018] Moreover, it is desirable for the thing which made the linear electric resistance heating element which generates heat by energization as a heating element in this invention crooked by the predetermined pattern to be used preferably, to connect the electrode for supplying the power for resistance heating from an external power source of supply in this case and wiring to the both ends of a heating element, and to cover the front face of a heating element with an electric insulation layer. Furthermore, it is desirable to prepare the heat-conduction film on an electric insulation layer so that opening of the ink feed holes may be carried out and the whole region of the heating field of a heating element may be covered because of improvement in an ink regurgitation property. The shape of an outline ring which has clinch two or more pile structure of the shape of the shape of a single ring and a concentric circle which has the lack section, the shape of an outline ring which have meandering structure, the shape of an outline rectangle that has clinch two or more pile structure of this continuous cardiac rectangle, the shape of an outline rectangle which has meandering structure, etc. can mention, and ink feed holes are made opening carrying out to the core of a ring or a rectangle as a pattern of crookedness of a heating element in these cases, for example.
[0019] In this invention, although it can arrange also to how as long as it is open for free passage to ink feed holes, for example, an ink container is formed in the field in which the heating element of an insulating base is not prepared, and, as for an ink container, an insulating base can constitute some walls [at least] of an ink container. Moreover, in order to raise the heating effectiveness of the ink by the heating element, a crevice may be formed so that the thickness of an insulating base may become thin at the rear-face side of the field in which a heating element and ink feed holes are formed in an insulating base compared with other fields.
[0020] Typically in each pressurized container, ink feed holes and an ink regurgitation nozzle counter. As for the opening diameter of an ink regurgitation nozzle, it is desirable to carry out whether it is almost the same as that of the opening diameter of ink feed holes rather than the opening diameter of ink feed holes. The wall which has taper structure which narrows toward an ink regurgitation nozzle from the insulating base side may be made to be prepared in the pressurized container. Moreover, the wall of the part which contains an ink regurgitation nozzle among the walls of a pressurized container can be formed with a metal from a viewpoint of cooling of ink. In order to keep constant the distance of an ink regurgitation nozzle and recorded media, a slot is formed in the skin of a pressurized container and an ink regurgitation nozzle may be made to carry out opening to the base of this slot.
[0021]
[Embodiment of the Invention] In the printer head of the side chute type mentioned above, for every heating element of each dot, the printer head of this invention is the location of the heating element which serves as a central field mostly, and prepares the ink feed holes which open an ink container and a pressurized container (ink heating container) for free passage in an insulating base. And in each pressurized container, an ink regurgitation nozzle is typically prepared in ink feed holes and the location which counters, respectively, and it has become the arrangement which adjoined the pressurized container and the ink container by using an insulating base as a septum. The pressurized container is separated for every dot, i.e., an ink regurgitation nozzle.
[0022] Drawing 9 is a perspective view explaining the circumference of ink feed-holes 4a for every dot in the gestalt of desirable operation of this invention. Ink feed-holes 4a which is a through tube is prepared in the insulating base 3, and in one field of an insulating base 3, heating element 5a of the shape of a circular ring (ring) which lacked one place arranges so that ink feed-holes 4a may be surrounded. On both sides of the lack part as a ring, one pair of metal wiring 13 has connected with the both ends of heating element 5a, respectively, and it can energize now to heating element 5a which is an electric resistance object.
[0023] As the Prior art also described, even if it is the electric resistance heating element structure of the shape of a conventional field by using a heating element ingredient with more high resistivity, the miniaturization of a heating element is possible, and it becomes more printable with a high definition. However, since the cross section of a heating element can be made small and extension of a heating element can be lengthened by considering as a linear configuration like heating element 5a shown in

drawing 9 , small and the heating element of high resistance can be obtained. Furthermore, by arranging heating element 5a so that ink feed-holes 4a may be surrounded in the center of heating element 5a, i.e., ink feed-holes 4a, the transmission efficiency of the heat from heating element 5a to ink can be raised so that it may mention later. Even if it is the case where the conventional heating element ingredient is used by constituting a printer head as mentioned above, the heating element which is smaller than before and can generate heat energy required for the ink regurgitation with low power in a short time can be obtained.
[0024] The configuration of linear heating element 5a is not restricted in the shape of [single] a ring, and the shape of a concentric circle-like clinch ring, the clinch rectangle of the same core or a meandering configuration, etc. can be used for it. Anyway, an ink regurgitation nozzle is arranged in the central upper part of the heating field of heating element 5a.
[0025] Drawing 10 (a) and (b) are drawings explaining the part equivalent to 1 dot of a printer head, and are a sectional view in a flat surface perpendicular to an insulating base 3. An illustration lower part side is equivalent to the ink container with which it fills up with ink 12 from an insulating base 3. The ink container is prepared in common to two or more ink regurgitation nozzles 7 which carry out the regurgitation of the ink of the same color. Moreover, the front face of heating element 5a is covered with the hard insulator layer 11 so that it may mention later. On the other hand, from the insulating base 3, the part of the illustration upper part is the pressurized container 14 for every dot, a right pair is carried out to ink feed-holes 4a, and the ink regurgitation nozzle 7 is formed in the field which counters an insulating base 3 among the wall surfaces of a pressurized container 14.
[0026] As shown in drawing 10 (a), the diameter of opening of ink feed-holes 4a is very small like the conventional printer head. For this reason, the ink in ink feed-holes 4a evaporates, and the inside of ink feed-holes 4a is permuted by the gas at the same time it energizes to heating element 5a and makes it generate heat. Moreover, it foams also in the ink 12 which is near the heating element 5a within a pressurized container 14, and becomes air bubbles 9, and non-evaporated ink flies [in a pressurized container 14] toward a projection and recorded media by the expansion force (illustration arrow head) of these air bubbles 9 from the ink regurgitation nozzle 7 as an ink droplet 8. Although foaming of the ink on heating element 5a is continued until the ink of the whole region of heating element 5a is permuted by the gas, and expansion of a gas is mostly saturated with heat insulation with a gas, the regurgitation of an ink droplet 8 is ended in the meantime. With this printer head, since the path which heat reveals to generation of heat and coincidence of heating element 5a through ink feed-holes 4a at an ink container side will be intercepted with air bubbles 9 and heat is revealed through the air bubbles 9 with small thermal conductivity, the adiabatic efficiency at the time of generation of heat of heating element 5a is heightened. That is, if the heating element of the conventional printer head compares with having heated the ink in an ink supply pipe that what is necessary is to heat the heating element in the printer head of this invention, and just to make it foam only in the ink in a pressurized container, it excels in thermal efficiency.
[0027] by the way -- if the coefficient of kinematic viscosity of the vapor phase by heating foaming is alike and large in the passage of minute size which is looked at by the head of an ink jet printer compared with the liquid phase and a mass flow rate compares -- a vapor phase -- the liquid phase -- a ratio -- it is known that it will be hard to flow to BE ****** (for example, the Mechanical Engineering Laboratory, Agency of Industrial Science and Technology issue, ****** news, No.3, 1995). In the pressurized container 14 shown in drawing 10 (a) and (b), when the opening diameter and tube length of ink feed-holes 4a and the ink regurgitation nozzle 7 are outline identitas Because the inside of ink feed-holes 4a serves as a vapor phase with heating by heating element 5a A bigger viscous drag than the ink of the liquid phase condition in the ink regurgitation nozzle 7 arises in the ink feed-holes 4a side, and an operation like the check valve to a fluid is carried out. By this The expansion pressure force by heating foaming of ink will be chiefly turned to the ink regurgitation nozzle 7 side, and when carrying out the regurgitation of the ink, it acts advantageously.
[0028] Or when extruding by the same pressure, and opening narrows gradually, an ink regurgitation rate increases and the directivity of a discharge direction is improved, at the same time it reduces the fluid resistance by the side of the ink discharge opening nozzle 7 by making the cross-section configuration of a pressurized container 14 into the taper configuration of a cone mold which narrows in the ink regurgitation nozzle 7 side from the heating element 5a side. furthermore, in drawing 10 (a) and (b), it sees typically -- as -- the opening diameter of the ink regurgitation nozzle 7 -- the opening diameter of ink feed-holes 4a -- a ratio -- BE ** -- large -- carrying out -- unsymmetrical passage configuration ****** -- on the other hand, a tropism property (diode characteristics) is added to the pressure loss by the side of ink feed-holes 4a by things, and the pressure by expansion of air bubbles concentrates on the ink regurgitation nozzle 7 side. Thereby, the conversion efficiency from the expansion pressure force to the kinetic energy of the ink droplet under flight is raised.
[0029] On the other hand, as shown in drawing 10 (b) at the time of cooling of heating element 5a, the gas in a pressurized container 14 contracts (illustration arrow head), the ink 12 of a liquid phase condition flows by the large flow rate in ink feed-holes 4a from an ink container according to the viscous difference of the liquid phase and a gaseous phase, and ink fills up coincidence for a short time in a pressurized container 14 by this. Moreover, the cooling rate of heating element 5a is brought forward by the inflow of the ink from an ink container.
[0030] By the way, since the heating element itself acts as a heat-regenerative element at the time of cooling in the case of the heating element of the shape of a conventional field, cooling takes time amount. On the other hand, since it can be regarded as a kind of fin structure to the top where the accumulation volume of the heating element itself is small when a linear heating element is used, a cooldown delay can be shortened. Therefore, a linear heating element is excellent in the responsibility of heating and cooling, and demonstrates power to the ink regurgitation in the short period accompanying highly minute printing.
[0031] Here, the discharge quantity of ink is the amount and outline tales doses of ink which are required for printing a single dot, supposing it is the minimum foaming gas and this capacity, according to the configuration of this invention, it can also make the minimal dose of the ink on a heating element this and outline tales doses, and low-power-ization of it by the miniaturization of a

pressurized container or a heating element will be attained. Namely, the ink of a quantum, then a constant rate can be made to breathe out efficiently the amount of the ink on heating element 5a by heating foaming now.

[0032] As mentioned above, the insulator layer 11 is formed in the front face of heating element 5a. The insulator layer 11 is arranged in order to prevent that the power which heating element 5a and ink 12 should contact directly electrically, and should use for heating essentially is revealed in view of various ion and a conductive particle being intermingled in ink 12. Moreover, on this insulator layer 11, the heat-conduction film may be prepared so that opening of the ink feed holes may be carried out and the whole heating field by heating element 5a may be covered. While being able to make now heating from a linear heating element into the shape of a field by preparing the heat-conduction film at homogeneity, it becomes possible to buffer the pressure impact of heating element HE by foaming and contraction of ink by this heat-conduction film, and the mechanical endurance of a heating element can be raised. The heat-conduction film is a metal membrane typically, and since ink 12 is contacted, heating element 5a has been separated electrically. When a linear heating element turns up and is formed, it is good to consider as the heat-conduction film of the shape of a field which fills the clearance between adjoining heating elements through an insulator layer.

[0033] By the way, although the heat generated by energizing to heating element 5a is transmitted in pressurized-container 14 direction and the insulating base 3 direction, an insulating base 3 functions as an insulating base 3 being thick as a heat sink, and the heat transfer effectiveness to ink falls. Then, it is possible to make it thin the optimal to extent which bears the thickness of the insulating base 3 of the part [directly under] of heating element 5a at a mechanical strength, and insulates heat required for short-time ink heating. Thus, with constituting, since the rear face of an insulating base 3 is always in contact with the ink 12 in an ink container, it is avoidable that an insulating base 3 serves as a heat sink. It realizes because making an insulating base 3 thin by the part [directly under] of heating element 5a forms in the rear face of an insulating base 3 a slot thru/or a crevice which is connected with the ink feed holes 4.

[0034] With this printer head, since the pressurized container 14 has dissociated every ink regurgitation nozzle 7 as mentioned above, a septum will exist between the adjoining pressurized containers 14. This septum has desirable configuration ****** with the viewpoint which transmits efficiently the heat generated with the heating element only to ink to a heat insulation nature ingredient. Moreover, a pressurized container 14 can process ingredients, such as glass and heat-resistant resin, using a phot lithography techniques, or can form them by cutting or mold processing. Furthermore, by using thermally conductive ingredients, such as a metal, as a charge of a wallplate of the field which contains the ink regurgitation nozzle 7 in a pressurized container 14, accumulation can be avoided, and cooling of the ink in the pressurized container by atmospheric air can be promoted now after the ink regurgitation, and it becomes possible to cool the heating element and ink in a pressurized container more for a short time.

[0035]

[Example] Next, an example explains this invention in more detail.

[0036] <<example 1>> Drawing 1 shows the cross-section structure of the ink jet printer head of the example 1 of this invention. With this printer head 1, the glass insulating base 3 is used and BSG (borosilicate glass; borosilicate glass) film 14a which has two or more circular through tubes is carrying out the laminating to the front face of an insulating base 3. It is the interior of each through tube of BSG film 14a, and ring-like heating element 5a is prepared in the front face of an insulating base 3, respectively. The front face of each heating element 5a is covered with the insulator layer 11 of the electric insulation which consists of silicon nitride (SiN) or BSG, and the metal heat-conduction film 15 is further formed in the front face of an insulator layer 11. Corresponding to a part for the core of ring-like heating element 5a, ink feed-holes 4a which is a through tube is formed in the insulating substrate 3. And the metal membrane 16 which consisted of aluminum film etc. carries out a laminating to BSG film 14a, and the ink regurgitation nozzle 7 which is a through tube is formed in the location which carries out a right pair to ink feed-holes 4a at the metal membrane 16. Thus, it means that the pressurized container 14 which uses an insulating base 3 as a base, makes BSG film 14a a side face, and makes a metal membrane 16 a top face was formed every ink regurgitation nozzle 7 by constituting.

[0037] On the other hand, the ink container 2 common to each ink regurgitation nozzle 7 made from plastics has pasted the rear-face side of an insulating base 3. And it is the rear-face side of an insulating base 3, and the part [directly under] of heating element 5a at least has become crevice 3a, and thickness of the insulating base 3 in the part [directly under] of heating element 5a is made thin the optimal, maintaining a mechanical strength.

[0038] Next, the manufacture approach of this printer head 1 is explained.

[0039] First, sputtering membrane formation is carried out, patterning of the TaN thin film is carried out to the front face of the glass insulating base 3, and heating element 5a of the outer diameter of 40 micrometers as shown in above-mentioned drawing 9 , and the shape of a ring with a line breadth of 10 micrometers which suffered a loss the part is formed. Furthermore, patterning of the aluminum thin film is formed and carried out, and the metal wiring 13 (refer to drawing 9) is formed in the both ends of heating element 5a.

[0040] Next, the heat-conduction film 15 is formed by forming an insulator layer 11, and forming and carrying out patterning of the metal film which, subsequently to the front face, has elevated-temperature thermal resistance, such as stainless steel film, by forming and carrying out patterning of the film, such as silicon nitride (SiN) or borosilicate glass (BSG), with a heat CVD method. Thus, the heating field of heating element 5a is covered with an insulator layer 11 and the heat-conduction film 15 at least. An insulator layer and the heat-conduction film are made not to be formed in main opening of ring-like heating element 5a, i.e., the part in which ink feed-holes 4a should be formed, in that case.

[0041] Thus, as opposed to the insulating base 3 in which heating element 5a, an insulator layer 11, and the heat-conduction film

15 were formed, BSG film 14a is formed by the thickness of 10 micrometers. Etching removal of the part which should carry out patterning of the BSG film 14a, and should serve as opening is carried out so that opening which are heating element 5a and a concentric circle, and arrives at even the front face of the heat-conduction film 15 and an insulating base 3 may be formed in BSG film 14a after it. furthermore -- until it applies the resist film (not shown) to the whole surface and the front face of the applied resist film reaches BSG film 14a -- CMP (chemical machinery-polish) -- flattening processing is performed by law. It means that the resist was evenly filled up with opening which built in the heating element, i.e., the part which should serve as a content volume part of a pressurized container 14, by this. In addition, you may make it use the SiN film etc. instead of BSG film 14a.
[0042] On the front face of BSG film 14a filled up with the resist, opening forms the metal membranes 16, such as aluminum, by the resist as mentioned above. On the other hand, crevice 3a is formed in this location so that the thickness of the insulating base 3 in the location [directly under] of heating element 5a may be set to 50 micrometers by machining at the rear-face side of the glass insulating base 3. Let the minimum width of face of crevice 3a be the outer diameter of heating element 5a.
[0043] Next, using laser beam processing, opening of the with a diameter of 10 micrometers ink feed-holes 4a is carried out to the location of the core of heating element 5a from the rear-face side of an insulating base 3, and opening of the ink discharge opening 7 with a diameter of 20 micrometers is similarly carried out to it from a metal membrane 16 side. Then, the resist which remains inside opening of BSG film 14a is dissolved and discharged, and a pressurized container 14 is formed.
[0044] The ink regurgitation nozzle 7 is arranged in the shape of a hound's-tooth check. It is setting the pitch in each train of the ink regurgitation nozzle 7 to 80 micrometers, shifting 40 micrometers of relative positions of an ink regurgitation nozzle, and forming them between the adjoining trains, and the printer head of 600dpi is constituted. If similarly the relative position of an ink regurgitation nozzle is shifted by making three or more trains into a period, it cannot be overemphasized that a still higher definition printer head can be formed.
[0045] Finally, the ink container 2 made from plastics is pasted up on the rear face of an insulating base 3, and it is filled up with ink in the ink container 2. It connects with the shift register IC (un-illustrating) mounted on the insulating base through the metal wiring 13 (refer to drawing 9), and each heating element 5a on an insulating base 3 is connected to the driver of the body of a printer (un-illustrating), CPU, a power source, etc. through a signal terminal (un-illustrating).
[0046] <<example 2>> Next, the printer head which changes a part of production process in the above-mentioned example 1, and is produced is explained using drawing 2 .
[0047] Formation of heating element 5a to an insulating base 3 top, an insulator layer 11, and the heat-conduction film 15 and patterning are performed like an example 1. And crevice 3a by the side of a rear face and ink feed-holes 4a (it is processed by a laser beam etc.) are formed in the insulating base 3. On the other hand, the covering plate 17 which consists of glass or heat resistant resin is prepared, the impression of the shape of a cylindrical shape which should serve as a pressurized container 14 is formed in this covering plate 17 by mold processing etc., and the ink regurgitation nozzle 7 is formed in it by laser beam processing etc. And a printer head is completed by pasting up the insulating base 3 and the covering plate 17 which were processed as mentioned above using adhesives 18, and attaching the ink container 2 further. In addition, reactive ion etching (RIE) and the optical-pumping dry etching method for having used the metal mask other than above-mentioned laser beam processing may be used for processing of ink feed-holes 4a or the ink regurgitation nozzle 7.
[0048] <<example 3>> In the printer head based on this invention, the configuration of a linear heating element established on an insulating base is not restricted to the thing of the shape of an above-mentioned single ring. For example, as shown in drawing 3 (a) - (d), respectively, it can consider as various configurations, such as the shape of the shape of the shape of a said alignment multiplex ring, and a said alignment multiplex rectangle, and a radiation ring, and a letter of meandering. Even if it is which configuration, it can form easily by using a phot lithography techniques. Moreover, in the above-mentioned example 1, the line breadth of a heating element is 10 micrometers, and can enough be reproduced in the 3-micrometer design Ruhr. Even if it is which case, it is desirable that the ink regurgitation nozzle 7 is located in the central upper part of the heating field of a heating element.
[0049] <<example 4>> As shown in drawing 4 , it is also possible to prepare ink feed-holes 4a outside the heating field of heating element 5a. In this case, it is desirable to make the pressurized container 14 of 2 yen into a connection configuration, and to make magnitude of the pressurization space to ink into the minimum.
[0050] <<example 5>> The configuration of a pressurized container 14 can be made into the thing of the taper configuration which was not restricted to a cylinder-like thing, for example, narrowed in the insulating base 3 side at the breadth ink regurgitation nozzle 7 side. Drawing 5 shows the printer head which has the pressurized container 14 equipped with the wall 19 of such a taper configuration. This printer head is the same procedure as an example 2, however can be easily realized by forming an impression in the covering plate 17 so that it may have the wall 19 of a taper configuration.
[0051] <<example 6>> In the printer head which explained the printer head shown in drawing 6 in the example 2 Slot 17a is both formed in the field which is large and carries out thickness of the covering plate 17 and which is the recorded-media 20 side of the covering plate 17. Recorded media 20 tend to be stuck to flat sides other than this slot 17a, these recorded media 20 tend to be moved in the direction perpendicular to the longitudinal direction of slot 17a, and it is going to keep constant the distance of recorded media 20 and the ink regurgitation nozzle 7. It was made to carry out opening of the ink regurgitation nozzle 7 to the base of slot 17a. In addition, if the covering plate 17 is processed by mold processing, it is also possible to coincidence-process the impression and slot 17a corresponding to a pressurized container 14 on the front rear face of the covering plate 17, and to form them in it.
[0052] With this printer head, the configuration at the time of the collision to the recorded media [specify / with the depth of slot

17a / the flight distance (namely distance of the ink regurgitation nozzle 7 and recorded-media 20 front face) of ink] of the ink droplet 8 which flew can be made regularity. Moreover, since the flight space of an ink droplet 8 is blockaded with the covering plate 17 and recorded media 20, turbulence of the flight direction by disturbance factors, such as an air current, can be prevented, and effectiveness is demonstrated to the imprint of the minute ink droplet accompanying highly-minute-izing of a printer head, and printing.

[0053]

[Effect of the Invention] as explain above , even if the conventional heating element ingredient be use for this invention by prepare the ink feed holes which open an ink container and a pressurized container (ink heating container) for free passage in the location of the heating element which serve as a central field mostly for every heating element of each dot in an insulating base , it become possible to make a contiguity printing dot space minute , and it be effective in the ability to manufacture now a small and high definition printer head by low cost . Moreover, since it can consider as the heating element of high electric resistance, without making thickness of a heating element extremely thin by using a linear heating element, it becomes possible to be able to reduce the power consumption of a printer head, to reduce the power-source load of the body of a printer by this, and to realize the pocket mold printer in which prolonged operation is possible. Moreover, in highly minute printing, there are exclusion of turbulence by disturbance, such as an air current, configuration control of a flight ink droplet, and effectiveness of being possible in this invention.

[Translation done.]